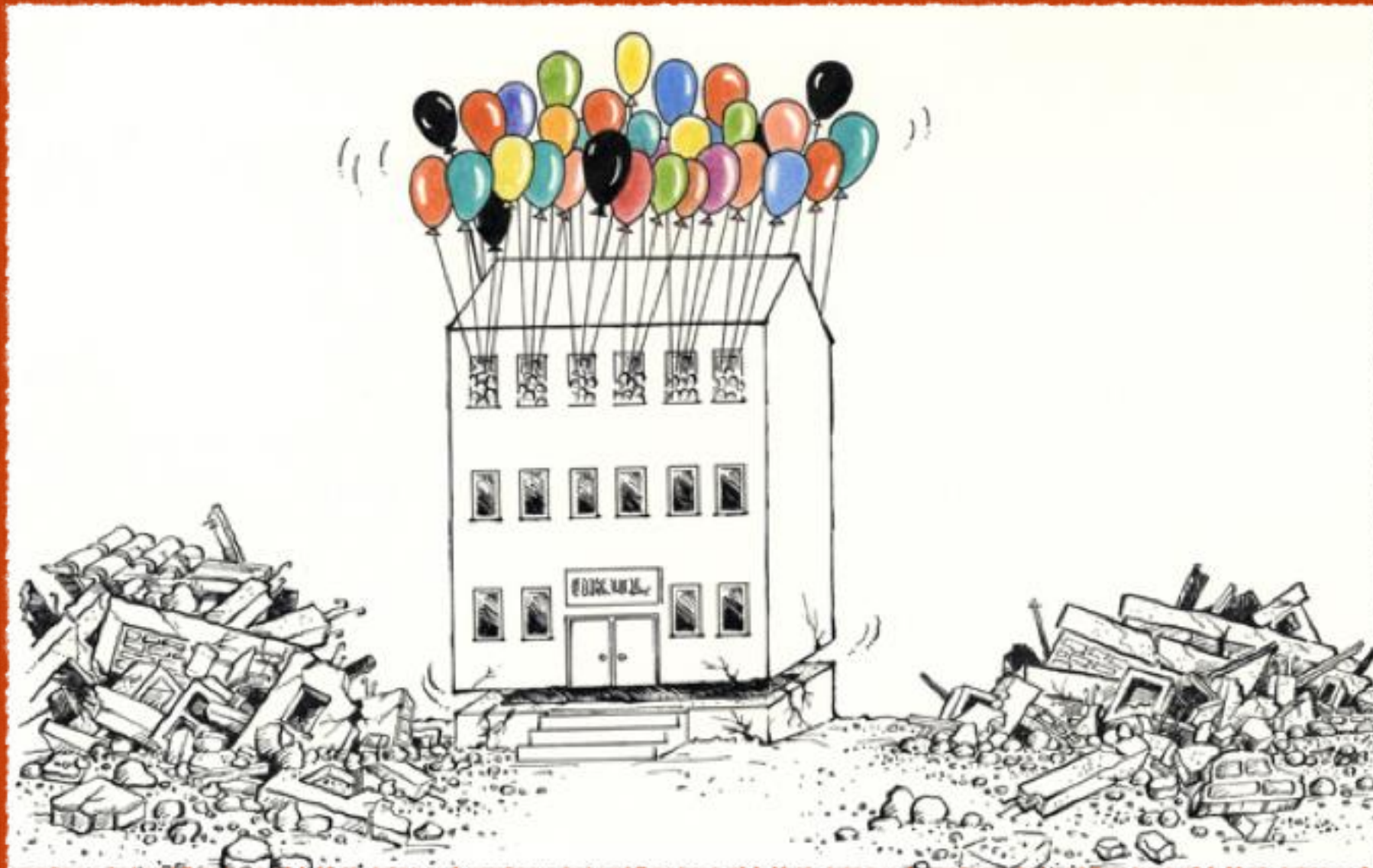


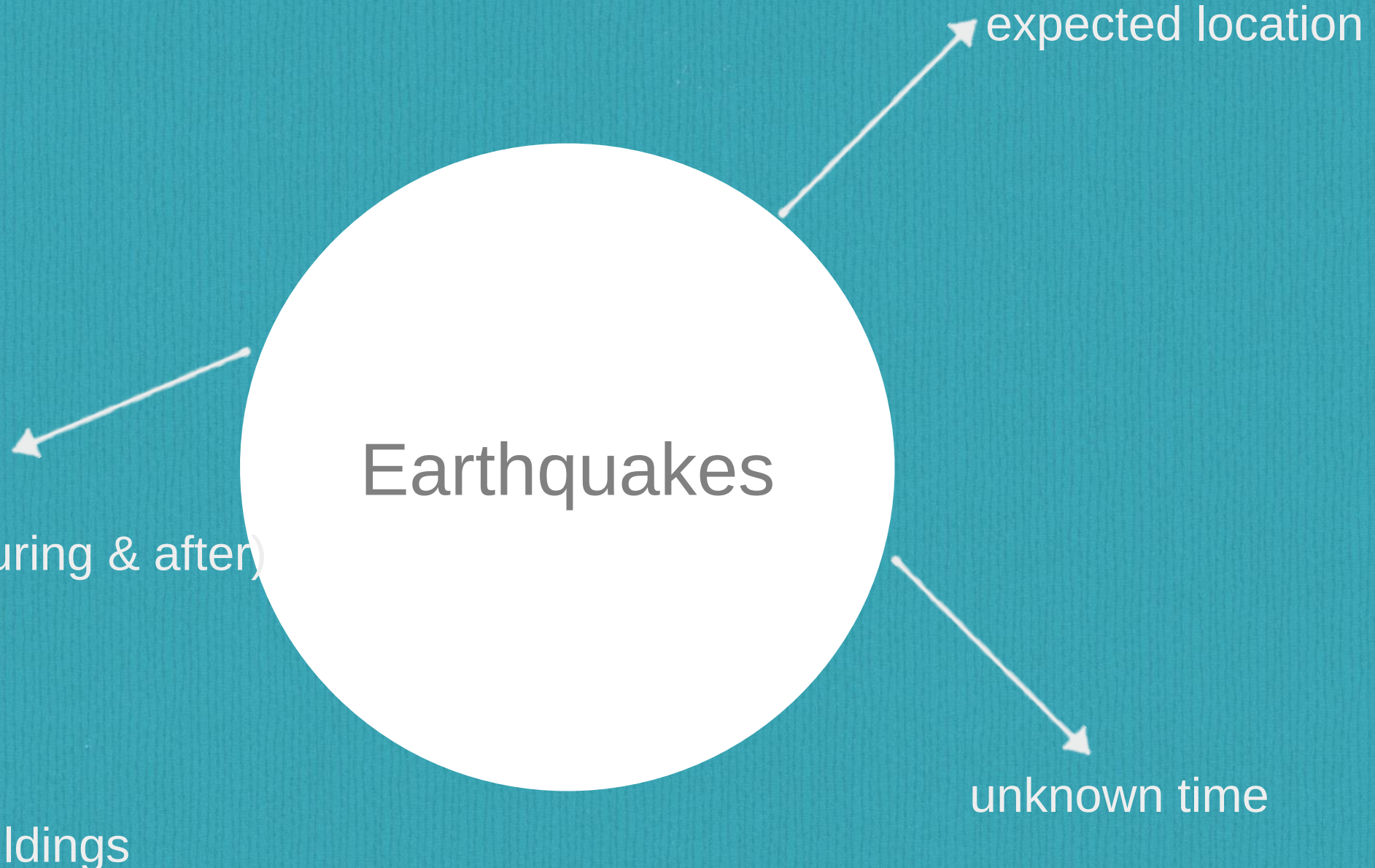


Earthquake Emergency Response

IE 482 - Humanitarian Logistics

Introduction

Earthquakes



```
graph TD; E((Earthquakes)) --> EL[expected location]; E --> UT[unknown time]; E --> GE[  
great effects (during & after)  
- tsunami  
- flood  
- fire  
- landslide  
- collapsed buildings];
```

expected location

great effects (during & after)

- tsunami
- flood
- fire
- landslide
- collapsed buildings

unknown time

Recent Earthquakes (World)

- 2004 Indian Ocean (230,000 fatalities)
 - 2005 Pakistan (80,000)
 - 2010 Haiti (316,000)
 - 2011 Japan (20,896)

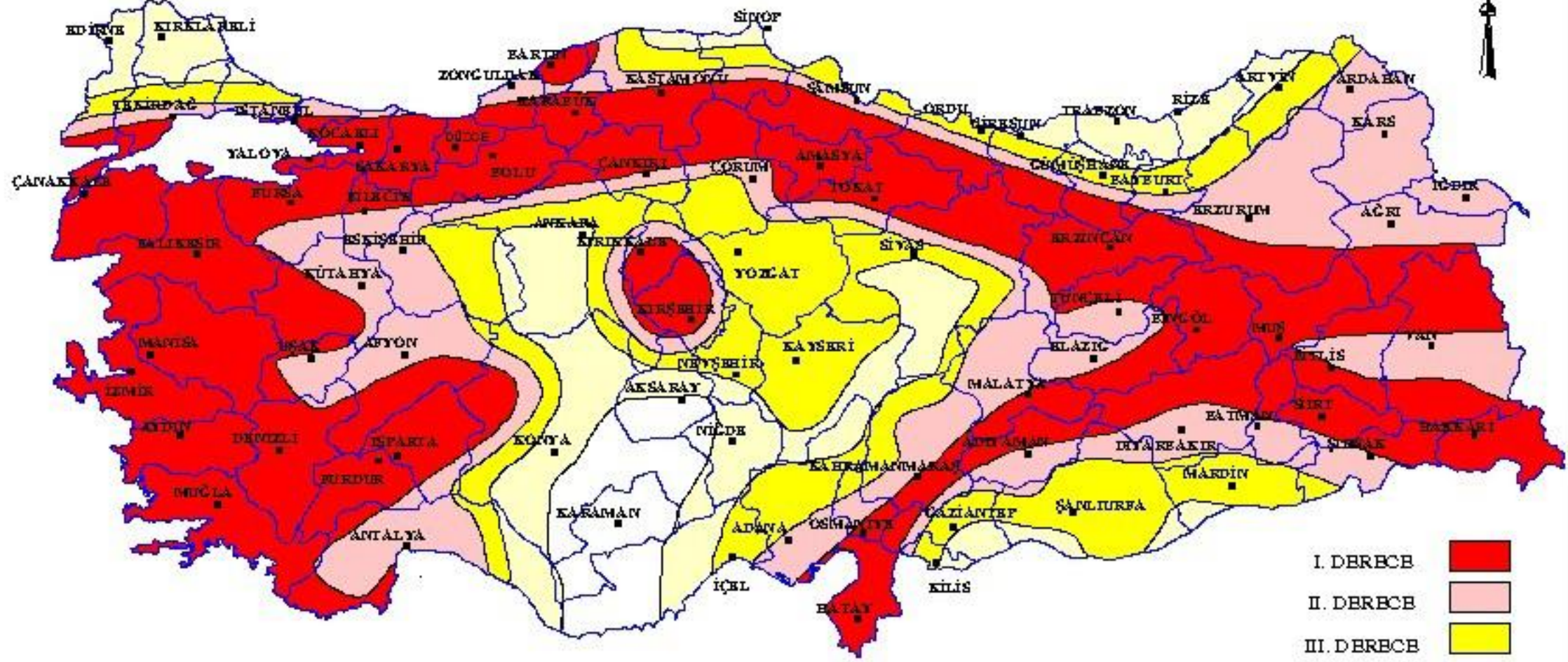
Recent Earthquakes (Turkey)

- 1992, Erzincan (498)
- 1995, Afyon, Dinar (90)
- 1998, Adana, Ceyhan (141)
- 1999, İzmit (45,954)
- 1999, Düzce (894)
- 2003, Bingöl (177)
- 2011, Van (604)

Recent Earthquakes (Turkey)

- 1999 İzmit, most destructive earthquake that Turkey ever since 1939 Erzincan Earthquake.(32, 700 fatalities)
- Organizations were not well prepared.
- TRC and municipalities were out of stocks.
- S & R operations were not organized.
(AKUT & Turkish Army)

Seismic Zone Map of Turkey



0 120 Kilometre

- I. DERECE
- II. DERECE
- III. DERECE
- IV. DERECE
- V. DERECE
- İl merkezi
- İl sınırı

AFET İŞLERİ GENEL MÜDÜRLÜĞÜ
DEPREM ARAŞTIRMA DAİRESİ
ANKARA-TÜRKİYE



S&R Operations are not well organized

IN TURKEY!

HOWEVER,

Time	Survival Percantage
First 30 mins	%93
1. day	%81
2. day	%36
3. day	%33
4. day	%19
5. day	%7

Logistics

Supplies and requirements for commodities of different categories.

First day	Food	Tent	Clothing	Medicine	Serum	Save & rescue equip.	Total (tons)
Requirements (tons)	2622.6	32782.3	6993.6	27.9	13.9	262.2	42702.5
Supplies (tons)	2098.1	26226.1	5594.9	22.4	11.2	209.8	34162.5
Second day							
Requirements (tons)	2908.7	3576.3	762.9	31.0	15.5	28.6	7323.0
Supplies (tons)	3199.6	3933.9	839.2	34.1	17.1	31.5	8055.4

Bakırköy Municipality

- Population
210,000
- Close to North Anatolian Fault Line
- BAKOM (Bakırköy Disaster Coordination Center)

Bakırköy Municipality

You, as a team will handle several problems under three main concepts:

1. In advance actions planning
2. Status Detection
3. Resource Assignment

Question 1: Consider the following buildings:

Hotel, Mall, Temples (Mosque, Church, Synagogue),
Training Center (dershane) , Hospital, Theatre,
Cinema, School, Retirement Home.

First, try to determine their priorities during an emergency response (instead of assigning individual weights, use groups/categories). Then, assuming 3 priority level (1: extremely urgent, 2: slightly urgent, 3: not urgent) try to determine the levels for each type of building for each time slot.

Question 2:

a) Consider the “Resources Table”. If we want to divide resources (both human and vehicle) into two categories as “Emergency Resources” (ER) and “Supportive resources” (SR). ER teams mainly perform Search and Rescue operations right after the earthquake. On the other hand OCR teams, visit shelters which are constructed after the earthquake and try to improve their life standards as much as possible. Which resources do you think belong to which category?

b) Assume BAKOM has 2 fully equipped ER-Team and an earthquake has just happened at 7 pm on Friday in March. Try to determine ER-Team's schedule for the first 24 hour. You are given the type and number of buildings and damage ratio of those buildings. "Critical Buildings Table". (1=completely demolished, 0=completely undamaged) Determine the time that ER Team should spend to rescue everybody in a visited building considering the damage ratio and the priority that you have assigned in Question 1.

Question 3:

There are 93 districts which have to receive service. You are given the distances between these districts, the population of each district, the risk coefficient of each link that connects the districts (if the risk coefficient is high then the probability that the link is out of use is also high.) The municipality plans to open distribution centers for basic aid. Since the roads and/or the vehicles may be damaged, people may walk to those distribution centers from districts.

- a) Assume the municipality will open 5 distribution centers. Give a mathematical model that determines the locations of DC's while minimizing the longest distance(R) that a person needs to travel to reach a DC.
- b) Now assume the municipality decides that each district should be covered by at least two DCs within a range(R). Use the R value that you have found in part a). How do you model this situation?

c) Conduct a sensitivity analysis on the number of distribution centers for part a) and give your results(corresponding R values).

d) Consider part a) again. But, this time assume the municipality also wants to consider the risk of destruction of the roads.(1=remains perfectly, 0=totally demolished) So, they want each district can access the DC that they are assigned to, using a link with a risk coefficient greater than 0,7. Again minimize the longest distance(R) that a person needs to travel to reach a DC.

Question 4:

a) Emergency Responce Center (ERC) considers using motorcycles right after an earthquake in order to have an idea about the status of districts in Bakırköy after the earthquake within 2 hours time. So that, they can send the Rescue Teams more efficiently. According to plan, each node should be visited by a motorcycle right after the earthquake. Assume the motorcycles are located in ERC(node #1 of the data set) and they can travel 30 km/h on the average. How many motorcycles do the ERC should purchase?

b) Now conduct a sensitivity analysis on part a. Decrease the total visit time from 2 hours to 1 hour with increments 0.25 hrs. Note the # of motorcycles for each step.

c) Now we want to relocate the ERC. Among the distribution centers that you open in Q3 part a, where do you move ERC. Use the number of motorcycles that you have found in part a.

d) Now assume we can locate the motorcycles in more than one DC's. (Still you will choose the motorcycle locations from Q3 part a) How many motorcycles should locate in which DC's, in order to visit all districts in 1 hour this time?

Important Dates

- Due date: December 22, 2017
- Office Hours:
 - December 12, 2017 – 12.40-13.40
 - December 19, 2017 – 12.40-13.40